

CLAIMS

WE CLAIM:

1. A miniature self contained sensor module for medical applications, comprising:
 - at least one substrate;
 - at least one miniature sensor disposed in part on the substrate;
 - an electrical circuit disposed on the substrate wherein the circuit:
 - receives operating power from a magnetic field with an inductor coil;
 - conditions a sensor signal;
 - transmits a conditioned sensor signal to an external signal detection system via magnetic telemetry.
2. The sensor module of claim 1, wherein the substrate is an integral part of the sensor.
3. The sensor module of claim 2, wherein the substrate is mechanically flexible.
4. The sensor module of claim 2, wherein the substrate is mechanically rigid.
5. The sensor module of claim 1, wherein the electrical connections for the electrical circuit and sensor are disposed on the substrate.
6. The sensor module of claim 1, wherein the electrical connections for the electrical circuit and sensor are disposed on a secondary substrate.

7. The sensor module of claim 1, wherein the electrical connections are apportioned among the first and second substrates.
8. The sensor module of claim 6, wherein the secondary substrate is flexible.
9. The sensor module of claim 1 wherein the connection of said substrate to said coil is achieved through one or more or a combination thereof the following:
 - solder,
 - wirebond,
 - flip chip technologies,
 - epoxy,
 - localized welding,
 - compression
 - thermal compression.
10. The sensor module of claim 1 wherein the connection of said substrate to said sensor is achieved through one or more or a combination thereof the following:
 - solder,
 - wirebond,
 - flip chip technologies,
 - epoxy,
 - localized welding,
 - compression
 - thermal compression.

11. The sensor module of claim 1 wherein the connection of said substrate to said electrical circuits is achieved through one or more or a combination thereof the following:

solder,

wirebond,

flip chip technologies,

expoxy,

localized welding,

compression

thermal compression.

12. The sensor module of claim 1, wherein the electrical circuit receives information from an external system.

13. The system of claim 1 wherein at least a portion of said sensor module is coated with one or more layers of thin coatings.

14. The system of claim 13 wherein the coating materials include but are not limited to one or more or any combination thereof:

silicone,

hydrogels,

parylene,

polymer,

nitrides,

oxides,
nitric-oxide generating materials,
carbides,
silicides,
titanium.

15. A miniature self contained sensor module for medical applications, comprising:
- a bottom substrate defining a cavity of five of six possible walls;
 - at least one miniature sensor or actuator disposed on the substrate;
 - an electrical circuit disposed in the bottom substrate cavity wherein the circuit:
 - receives operating power from a magnetic field with an inductor coil;
 - conditions a sensor signal;
 - transmits a conditioned sensor signal to an external signal detection system via magnetic telemetry;
 - a top substrate enclosing the sensor and electronics by forming the sixth cavity wall.
16. The sensor module of claim 15 wherein the sensors include a pressure sensor.
17. The sensor module of claim 15, wherein the sensors include a pressure and temperature sensor.
18. The sensor module of claim 15, wherein the sensors include two pressure sensors.

19. The sensor module of claim 15, wherein one or more sensors and/or actuators are present.

20. The sensor module of claim 15, wherein the electrical connections for the electrical circuit and sensor are disposed on a secondary substrate.

21. The sensor module of claim 20, wherein the secondary substrate is flexible.

22. The sensor module of claim 21, wherein the flexible substrate connects to the sensor at a recess in the bottom substrate.

23. The sensor module of claim 22, wherein the flexible substrate aligns with the bottom substrate recess with a matched wedge shape.

24. The system of claim 15 wherein at least a portion of said sensor module is coated with one or more layers of thin coatings.

25. The system of claim 24 wherein the coating materials include but are not limited to one or more or any combination thereof:

silicone,

hydrogels,

parylene,

polymer,

nitrides,

oxides,
nitric-oxide generating materials,
carbides,
silicides,
titanium.

26. A miniature implant for measuring physiologic parameters for medical applications, comprising:

Implantable self-contained sensor module for measuring physiologic parameters wherein the module:

senses physiologic parameters with a sensor;

receives operating power from a magnetic field with an inductor coil;

conditions a sensor signal;

transmits a conditioned sensor signal to an external signal detection system via magnetic telemetry;

outer shell to house sensor module fit with anchoring mechanism for implantation.

27. The system of claim 26 wherein said implantable sensing device is implanted using a minimally invasive outpatient technique

28. The miniature implant of claim 26 wherein the implant is delivered and implanted with a catheter.

29. The miniature implant of claim 26 wherein the anchoring mechanism passes through a septum wall and opens on either side of a septal wall, clamping the implant to the wall.
30. The system of claim 29 wherein said anchoring mechanism utilizes an anchor that passes through the atrial septum.
31. The system of claim 30 wherein the anchoring method is similar to anchoring of septum occluder devices, wherein two umbrella-shaped anchors one on each side which anchor the sensing device.
32. The system of claim 30 wherein the larger portion of said implantable sensing device is located in the right side of the heart and the smaller portion of said implantable sensing device is located in the left side and includes at minimum
33. The miniature implant of claim 26 wherein the anchoring mechanism is a helical screw.
34. The miniature implant of claim 26 wherein the anchoring mechanism is a tine that expands and catches on a trabeculated area of the heart.
35. The system of claim 26 wherein said anchoring mechanism is made from one or more or any combination thereof the following materials:
- nitinol,
 - teflon,
 - stainless steel,

polymer,
titanium,
biocompatible metals.

36. The system of claim 26 wherein at least a portion of said sensor module is coated with one or more layers of thin coatings.

37. The system of claim 36 wherein the coating materials include but are not limited to one or more or any combination thereof:

silicone,
hydrogels,
parylene,
polymer,
nitrides,
oxides,
nitric-oxide generating materials,
carbides,
silicides,
titanium.

38. A wireless sensing system for medical applications, comprising:

Implantable self-contained sensor module for measuring physiologic parameters wherein the module:

senses physiologic parameters with a sensor;
receives operating power from a magnetic field with an inductor coil;
conditions a sensor signal;
transmits a conditioned sensor signal to an external signal detection system via
magnetic telemetry;

External readout unit wherein the unit:

transmits magnetic field to power the sensor module;
receives a signal from the implant module.

39. The wireless sensing system of claim 38 wherein the external readout unit communicates information to the implant.

40. The wireless sensing system of claim 38 wherein the external readout unit interfaces to a display for the user.

41. The wireless sensing system of claim 38 wherein the external readout unit interfaces to a computer for data storage.

42. The wireless sensing system of claim 38 wherein the computer interfaces with a computer network.

43. The wireless sensing system of claim 38 wherein the external readout unit processes the data for indicating urgency of medical attention.

44. The wireless sensing system of claim 38 wherein said external readout unit is capable of performing one or more of the following:

remote monitoring of patients, including but not limited to home monitoring;

monitoring of congestive heart failure patients with telephone-based (or similar method) data and information delivery;

monitoring of patients with wireless telephone-based (or similar method) data and information delivery;

monitoring of congestive heart failure patients with web-based (or similar method) data and information delivery;

closed-loop drug delivery to treat diseases;

closed-loop pacemaker parameter tuning to treat related diseases;

warning systems for critical worsening of diseases and related conditions;

portable or ambulatory monitoring or diagnostic systems;

battery-operation capability;

data storage;

reporting global positioning coordinates for emergency applications;

communication with other medical devices including but not limited to pacemakers, defibrillator, implantable cardioverter defibrillator, implantable drug delivery systems, non-implantable drug delivery systems, and wireless medical management systems.

45. The system of claim 38 wherein said readout unit includes a barometric pressure sensor.

46. The system of claim 45 wherein said barometric pressure sensor is used to compensate for variations in atmospheric pressure.

47. The system of claim 38 wherein said implantable sensing system is implanted using a minimally invasive outpatient technique.
48. The miniature implant of claim 38 wherein the implant is delivered and implanted with a catheter.
49. The miniature implant of claim 38 wherein the anchoring mechanism passes through a septum wall and opens on either side of a septal wall, clamping the implant to the wall.
50. The system of claim 38 wherein said anchoring mechanism utilizes an anchor that passes through the atrial septum.
51. The system of claim 50 wherein the anchoring method is similar to anchoring of septum occluder devices, wherein two umbrella-shaped anchors one on each side which anchor the sensing device.
52. The system of claim 50 wherein the larger portion of said implantable sensing device is located in the right side of the heart and the smaller portion of said implantable sensing device is located in the left side and includes at minimum
53. The miniature implant of claim 38 wherein the anchoring mechanism is a helical screw.

54. The miniature implant of claim 38 wherein the anchoring mechanism is a tine that expands and catches on a tribeculated area of the heart.

55. The system of claim 38 wherein said anchoring mechanism is made from one or more or any combination thereof the following materials:

nitinol,

teflon,

stainless steel,

polymer,

titanium,

biocompatible metals.

56. The system of claim 38 wherein at least a portion of said sensor module is coated with one or more layers of thin coatings.

57. The system of claim 56 wherein the coating materials include but are not limited to one or more or any combination thereof:

silicone,

hydrogels,

parylene,

polymer,

nitrides,

oxides,

nitric-oxide generating materials,
carbides,
silicides,
titanium.

58. The sensor module of claim 1 wherein said module is used for applications including but not limited to one or more of the following:

cardiovascular diseases,
congestive heart failure,
congenital heart diseases,
diseases related to intracranial pressure,
abdominal aortic aneurysm,
intraocular pressure for eye related diseases including but not limited to glaucoma,
urinary diseases,
gastrointestinal diseases.

59. The sensor module of claim 15 wherein said module is used for applications including but not limited to one or more of the following

cardiovascular diseases,
congestive heart failure,
congenital heart diseases,
diseases related to intracranial pressure,
abdominal aortic aneurysm,

intraocular pressure for eye related diseases including but not limited to glaucoma,
urinary diseases,
gastrointestinal diseases.

60. The implant of claim 26 wherein said module is used for applications including but not limited to one or more of the following

cardiovascular diseases,
congestive heart failure,
congenital heart diseases,
diseases related to intracranial pressure,
abdominal aortic aneurysm,
intraocular pressure for eye related diseases including but not limited to glaucoma,
urinary diseases,
gastrointestinal diseases.

61. The wireless sensing system of claim 38 wherein said module is used for applications including but not limited to one or more of the following

cardiovascular diseases,
congestive heart failure,
congenital heart diseases,
diseases related to intracranial pressure,
abdominal aortic aneurysm,
intraocular pressure for eye related diseases including but not limited to glaucoma,

urinary diseases,
gastrointestinal diseases.

62. The sensor module of claim 1 wherein sensor measures one or more of the following parameters

pressure,
temperature,
flow ,
blood composition,
blood gas content,
chemical composition,
acceleration,
vibration.

63. The sensor module of claim 15 wherein sensor measures one or more of the following parameters

pressure,
temperature,
flow ,
blood composition,
blood gas content,
chemical composition,
acceleration,

vibration.

64. The sensor module of claim 26 wherein sensor measures one or more of the following

parameters

pressure,

temperature,

flow ,

blood composition,

blood gas content,

chemical composition,

acceleration,

vibration.

65. The sensor module of claim 38 wherein sensor measures one or more of the following

parameters

pressure,

temperature,

flow ,

blood composition,

blood gas content,

chemical composition,

acceleration,

vibration.

66. The sensor module of claim 26 wherein one or more sensing devices are measuring one or more physiological parameters relating to one or more internal organs

67. The sensor module of claim 66 wherein said physiological parameters include pressure.

68. The sensor module of claim 66 wherein said internal organs include but are not limited to one or more of the following organs:

heart,

brain,

kidney,

lung,

abdomen.

69. The sensor module of claim 67 wherein one or more sensing devices are measuring one or more of the following pressures:

left ventricular end diastolic pressure,

left atrium,

left atrium appendage,

mean left atrium pressure,

left side of the heart,

right side of the heart,

right atrium,

mean right atrium pressure,
right ventricular end diastolic pressure,
differential pressure between left and right atrium,
intracranial pressure,
intraocular pressure.

70. The sensor module of claim 38 wherein one or more sensing devices are measuring one or more physiological parameters relating to one or more internal organs

71. The sensor module of claim 70 wherein said physiological parameters include pressure.

72. The sensor module of claim 70 wherein said internal organs include but are not limited to one or more of the following organs"

heart,
brain,
kidney,
lung,
abdomen.

73. The sensor module of claim 71 wherein one or more sensing devices are measuring one or more of the following pressures:

left ventricular end diastolic pressure,
left atrium,

left atrium appendage,
mean left atrium pressure,
left side of the heart,
right side of the heart,
right atrium,
mean right atrium pressure,
right ventricular end diastolic pressure,
differential pressure between left and right atrium,
intracranial pressure,
intraocular pressure.